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ABSTRACT

The Iowa Assessment program used criterion referenced tests developed for use with students in grades 5 and 8. Participation by local school districts was on a voluntary basis. Lists of minimal objectives were developed after reviewing textbooks and objectives identified by the National Assessment of Educational Progress. These objectives were reviewed by mathematics teachers, and from them 58 were selected for the beginning fifth-grade level and 62 for the beginning eighth-grade level. Four items were written for each objective. This document presents the lists of objectives and percent of students tested who displayed mastery of each objective. (SD)

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Iowa Assessment Report in Mathematics

1975-76 School Year

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Because of a growing concern over current measuring instruments and in response to criticisms regarding student achievement in mathematics, members of the Iowa Council of Teachers of Mathematics (ICTM) and staff from the Iowa Department of Public Instruction initiated a program for statewide mathematics assessment in June 1974. It was designed to collect pertinent and specific data on student achievement that could be used by teachers in diagnosing and prescribing instruction. To assist the Department staff in developing and implementing the program, a nine member committee consisting of classroom teachers, mathematics supervisors and college mathematics instructors was established. The committee's initial role was to establish criteria for an effective assessment program and to monitor progress.

The goals of statewide mathematics assessment were:

1. To provide specific information on each student which could be used by the teacher to diagnose each student's strengths and weaknesses in mathematics;

2. To provide objective data for each teacher to furnish the basis for planning sequential learning activities for the entire class or for each individual in the class;

3. To provide data for school districts that could be used in revising the curriculum and in planning inservice activities for the staff;

4. To provide benchmark information to the Iowa Department of Public Instruction so that performance trends over time can be studied; and

5. To provide a process which could be replicated by local school districts in determining the effectiveness of each curricular offering.

After the committee reviewed procedures used by National Assessment in identifying objectives and test items and the techniques used to sample students and items, the committee developed the following criteria for the Iowa Assessment program:

1. Participation by local schools in the assessment program would be on a voluntary basis;

2. A list of minimal performance objectives would be identified to insure that important objectives are not overlooked;

3. Student testing would be limited to the cognitive domain with only grades five and eight included.

4. Four items would be developed to measure the attainment of each objective;

5. The test would differ from a norm-referenced test in that it would not be designed for the purpose of comparing one student's performance with that of another;

6. The entire test battery would be administered to each student so that the data could be used for diagnostic purposes;

7. Test items would be developed which would incorporate the use of recall, application and analysis skills;

8. The test would be administered early in the school year to enable the teacher to utilize the data in planning instructional activities throughout the year;

9. Test scoring would be the responsibility of the classroom teacher with the results reported to the student as soon after testing as possible;

10. Each student's performance would be recorded on a single page profile sheet to be developed by the committee;

11. Assessment items would be limited to those which could be measured by paper and pencil;

12. The major focus of the assessment would be to provide the teacher with data for making decisions on individual students; and

13. Collection of the data at the state level would be for the purpose of identifying problems common to a number of schools and to provide baseline data which would be used to study performance trends over time.

The state assessment program did not attempt to measure proficiency on all desirable mathematics skills and concepts. Many worthwhile experiences such as constructing geometric figures using compass and ruler or estimating the length, height, or weight of objects in the classroom were not included.

A set of minimal objectives was identified for beginning fifth and eighth grade students following an extensive survey of current textbook content and after reviewing mathematics objectives identified by other states and those identified in National Assessment. Iowa's objectives were based upon skills and concepts deemed essential for future success in mathematics, or skills required to deal with solving practical problems in everyday life situations. The first list of objectives developed were submitted to 150 mathematics teachers throughout the state for comments regarding their appropriateness. Revisions were made and items were developed to measure student performance on each objective. These items were pilot tested in four school districts and the test was then revised.

Local school districts were invited to participate in mathematics assessment in March 1975. Requests for participation came from 140 school districts throughout the state resulting in the distribution of some 20,000 fifth grade tests and 22,000 eighth grade tests.

Mathematics teachers from the participating schools were asked to review the objectives and test items prior to administering the test. A part of the review included getting expected levels of performance for each class. Each teacher was asked to estimate the per cent of students he/she believed would demonstrate mastery on each objective. This information would then be useful to the teacher in analyzing the results as he/she could compare the actual performance against the expected level of performance.

To assure comparability of data, local teachers were requested to administer the assessment tests between September 15, and October 17, 1975. Teachers were to score the tests and record the results on individual profile sheets. Individual profiles were to be recorded on a class profile or school profile and forwarded to the Iowa Department of Public Instruction where a state profile was to be developed. As participation was voluntary, schools who did not elect to send in class or school profiles were not contacted to submit a report.

A unique feature of the Iowa Assessment Program which distinguishes it from programs in other states is the assistance provided to the teacher prior to and following the assessment. Area education agency consultants and local school math coordinators arranged pre- and post-test assessment activities with local teachers. For example, a consultant would schedule a meeting of the staff to validate the objectives. Teachers would compare local objectives against those included in the assessment. Consultative assistance was also available to assist the teacher in analyzing the results and to determine appropriate instructional activities.

The State Mathematics Committee developed the following aids: an assessment handbook to explain the how and why of assessment; a guide for diagnosing errors on the fifth grade test; cassette tapes of all fifth and eighth grade test items for individual administration; and a list of suggested instructional activities for the measurement strand focusing on objectives included in the assessment. Other guides are to be developed upon the request of the teachers.

Due to the length of the test when four items were used to measure the attainment of each objective, the committee suggested that the test be divided into two forms. This resulted in each objective being measured by only two test items. One should bear this in mind when analyzing the statewide summary of fifth and eighth grade student performance illustrated in graphic form on the following pages.*

*You may want to refer to the entire objective statement when reviewing the results.

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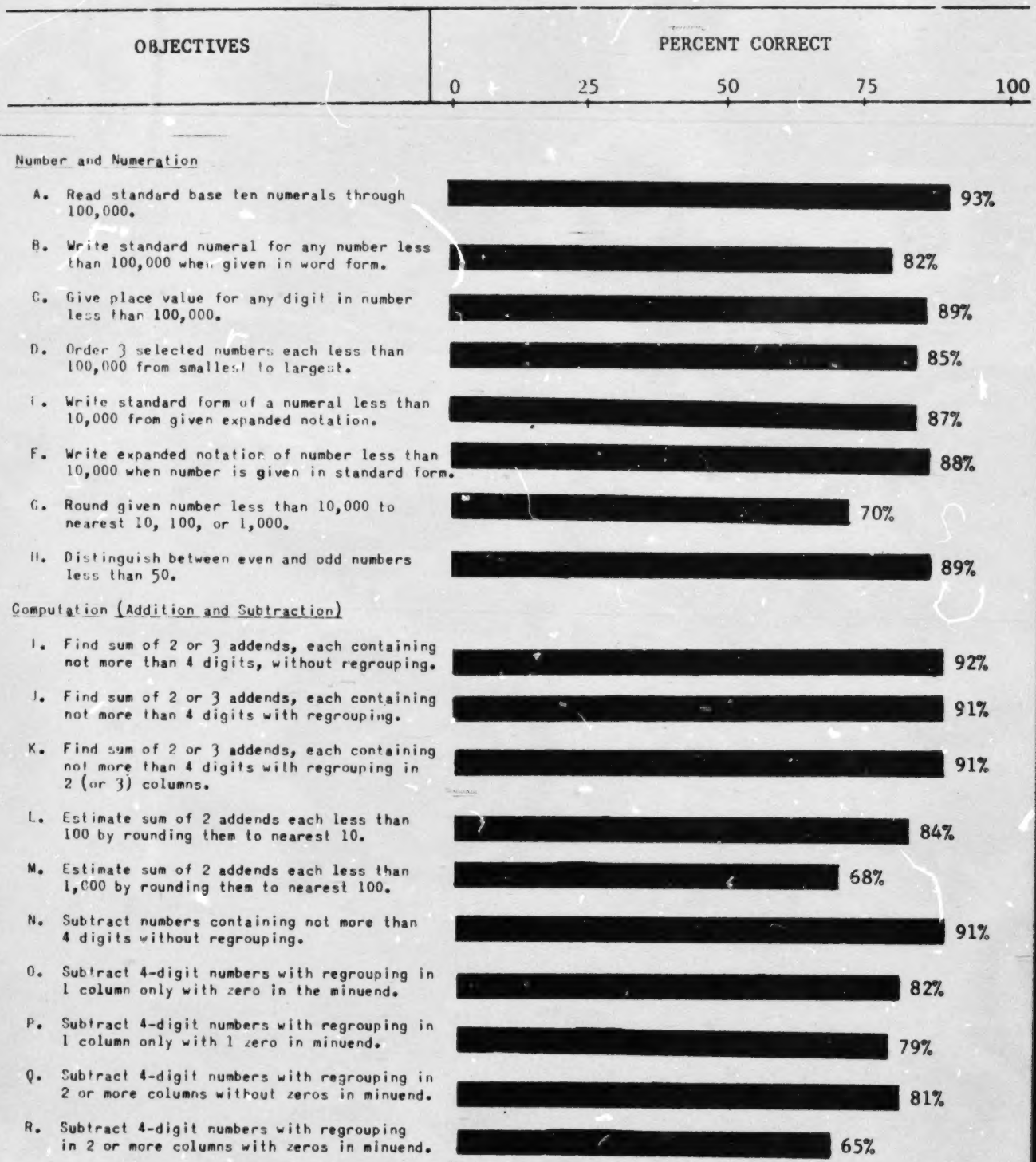
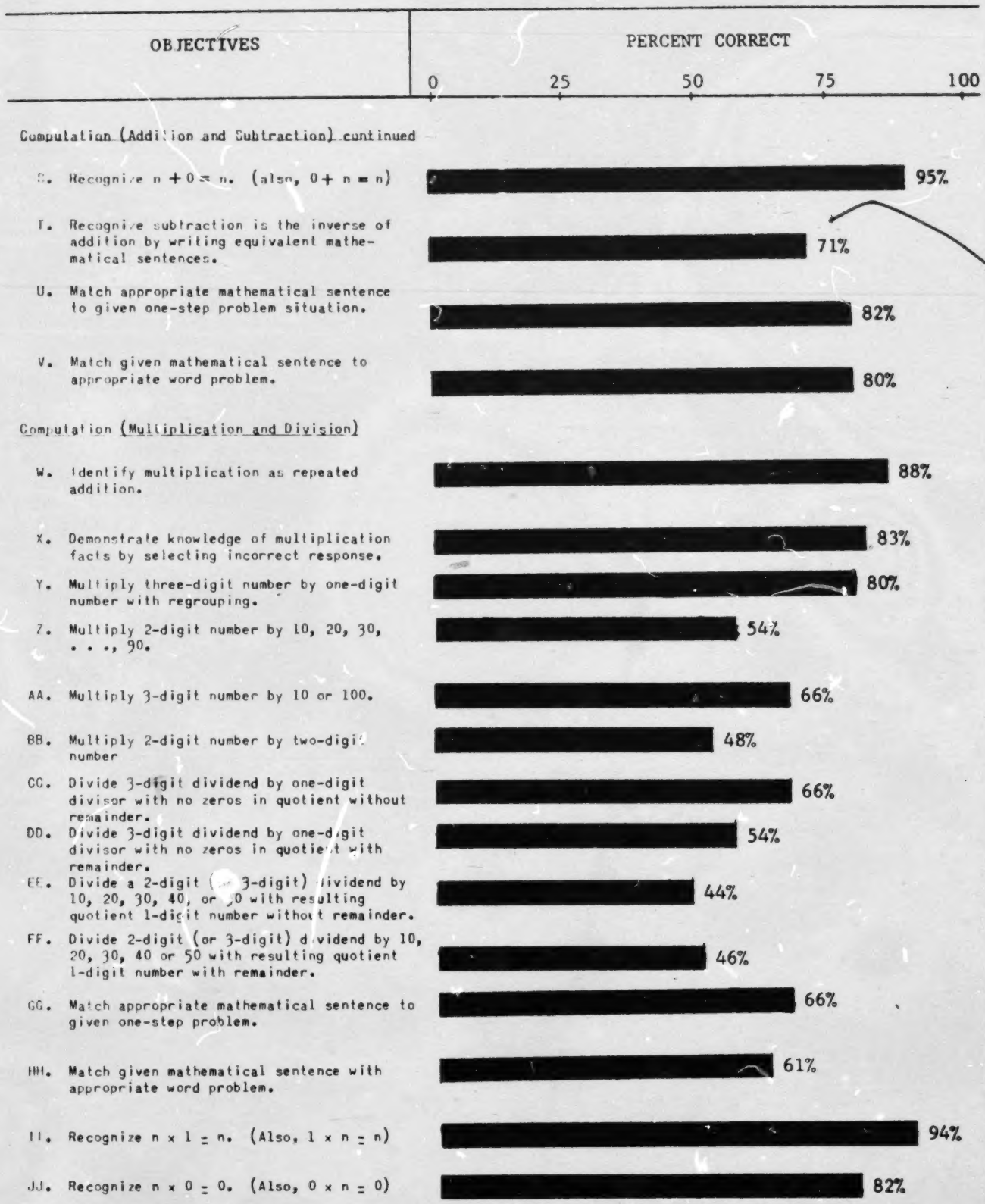
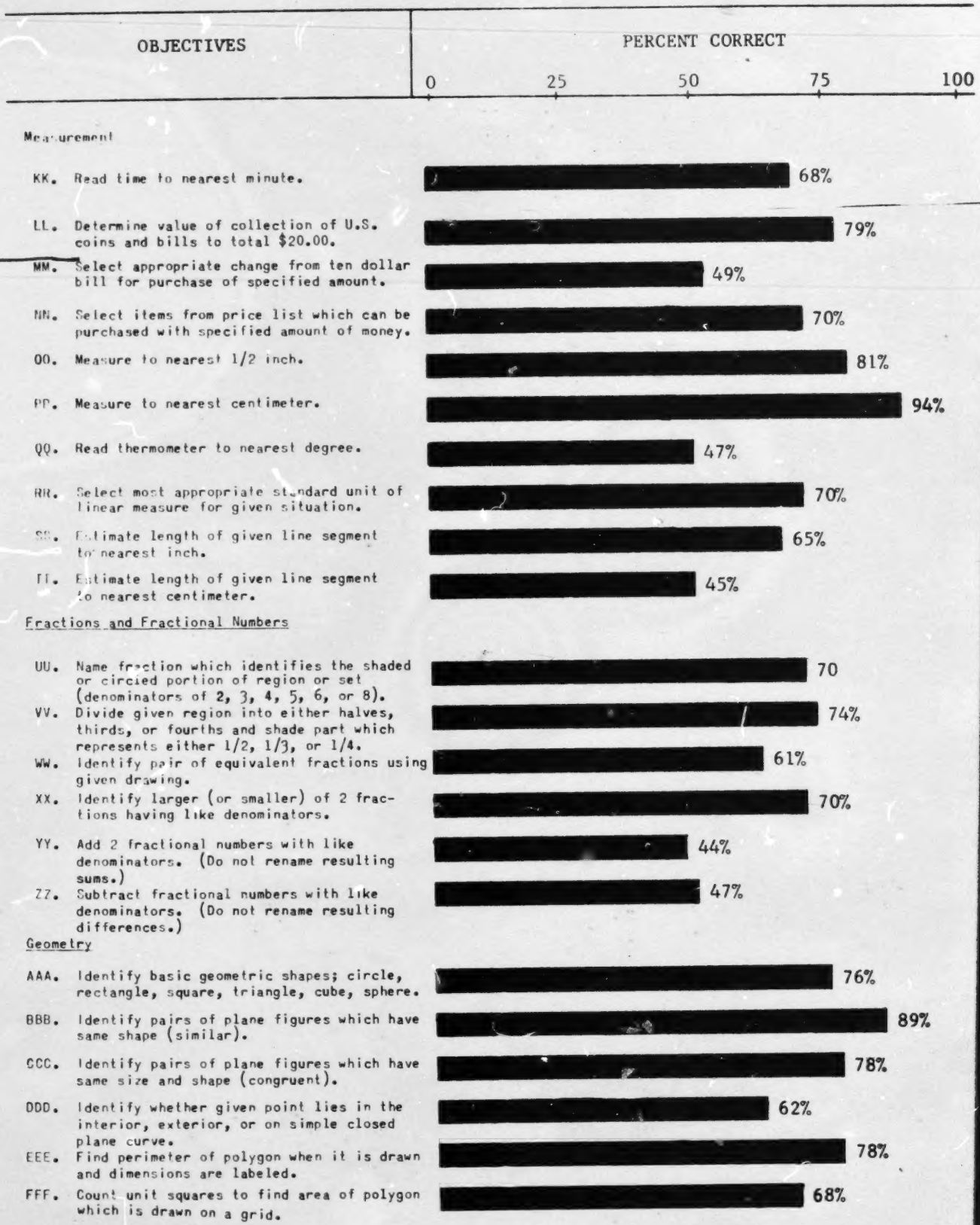
5TH GRADE STUDENT PERFORMANCE ON MATHEMATICS OBJECTIVES (11,528 Students)


OBJECTIVES
PERCENT CORRECT
0
25
50
75
100
Number and Numeration
A. Read standard base ten numerals through 100,000.
93%
B. Write standard numeral for any number less than 100,000 when given in word form.
82%
C. Give place value for any digit in number less than 100,000.
89%
D. Order 3 selected numbers each less than 100,000 from smallest to largest.
85%
E. Write standard form of a numeral less than 10,000 from given expanded notation.
87%
F. Write expanded notation of number less than 10,000 when number is given in standard form.
88%
G. Round given number less than 10,000 to nearest 10, 100, or 1,000.
70%
H. Distinguish between even and odd numbers less than 50.
89%
Computation (Addition and Subtraction)
I. Find sum of 2 or 3 addends, each containing not more than 4 digits, without regrouping.
92%
J. Find sum of 2 or 3 addends, each containing not more than 4 digits with regrouping.
91%
K. Find sum of 2 or 3 addends, each containing not more than 4 digits with regrouping in 2 (or 3) columns.
91%
L. Estimate sum of 2 addends each less than 100 by rounding them to nearest 10.
84%
M. Estimate sum of 2 addends each less than 1,000 by rounding them to nearest 100.
68%
N. Subtract numbers containing not more than 4 digits without regrouping.
91%
O. Subtract 4-digit numbers with regrouping in 1 column only with zero in the minuend.
82%
P. Subtract 4-digit numbers with regrouping in 1 column only with 1 zero in minuend.
79%
Q. Subtract 4-digit numbers with regrouping in 2 or more columns without zeros in minuend.
81%
R. Subtract 4-digit numbers with regrouping in 2 or more columns with zeros in minuend.
65%

GRADE 5


OBJECTIVES
PERCENT CORRECT
0
25
50
75
100
Computation (Addition and Subtraction) continued
S. Recognize n + 0 = n. (also, 0 + n = n)
95%
T. Recognize subtraction is the inverse of addition by writing equivalent mathematical sentences.
71%
U. Match appropriate mathematical sentence to given one-step problem situation.
82%
V. Match given mathematical sentence to appropriate word problem.
80%
Computation (Multiplication and Division)
W. Identify multiplication as repeated addition.
88%
X. Demonstrate knowledge of multiplication facts by selecting incorrect response.
83%
Y. Multiply three-digit number by one-digit number with regrouping.
80%
Z. Multiply 2-digit number by 10, 20, 30, . . ., 90.
54%
AA. Multiply 3-digit number by 10 or 100.
66%
BB. Multiply 2-digit number by two-digit number
48%
CC. Divide 3-digit dividend by one-digit divisor with no zeros in quotient without remainder.
66%
DD. Divide 3-digit dividend by one-digit divisor with no zeros in quotient with remainder.
54%
EE. Divide a 2-digit (or 3-digit) dividend by 10, 20, 30, 40, or 50 with resulting quotient 1-digit number without remainder.
44%
FF. Divide 2-digit (or 3-digit) dividend by 10, 20, 30, 40 or 50 with resulting quotient 1-digit number with remainder.
46%
GG. Match appropriate mathematical sentence to given one-step problem.
66%
HH. Match given mathematical sentence with appropriate word problem.
61%
II. Recognize n x 1 = n. (Also, 1 x n = n)
94%
JJ. Recognize n x 0 = 0. (Also, 0 x n = 0)
82%

GRADE 5


OBJECTIVES
PERCENT CORRECT
0
25
50
75
100
Measurement
KK. Read time to nearest minute.
68%
LL. Determine value of collection of U.S. coins and bills to total $20.00.
79%
MM. Select appropriate change from ten dollar bill for purchase of specified amount.
49%
NN. Select items from price list which can be purchased with specified amount of money.
70%
OO. Measure to nearest 1/2 inch.
81%
PP. Measure to nearest centimeter.
94%
QQ. Read thermometer to nearest degree.
47%
RR. Select most appropriate standard unit of linear measure for given situation.
70%
SS. Estimate length of given line segment to nearest inch.
65%
TT. Estimate length of given line segment to nearest centimeter.
45%
Fractions and Fractional Numbers
UU. Name fraction which identifies the shaded or circled portion of region or set (denominators of 2, 3, 4, 5, 6, or 8).
70
VV. Divide given region into either halves, thirds, or fourths and shade part which represents either 1/2, 1/3, or 1/4.
74%
WW. Identify pair of equivalent fractions using given drawing.
61%
XX. Identify larger (or smaller) of 2 fractions having like denominators.
70%
YY. Add 2 fractional numbers with like denominators. (Do not rename resulting sums.)
44%
ZZ. Subtract fractional numbers with like denominators. (Do not rename resulting differences.)
47%
Geometry
AAA. Identify basic geometric shapes; circle, rectangle, square, triangle, cube, sphere.
76%
BBB. Identify pairs of plane figures which have same shape (similar).
89%
CCC. Identify pairs of plane figures which have same size and shape (congruent).
78%
DDD. Identify whether given point lies in the interior, exterior, or on simple closed plane curve.
62%
EEE. Find perimeter of polygon when it is drawn and dimensions are labeled.
78%
FFF. Count unit squares to find area of polygon which is drawn on a grid.
68%

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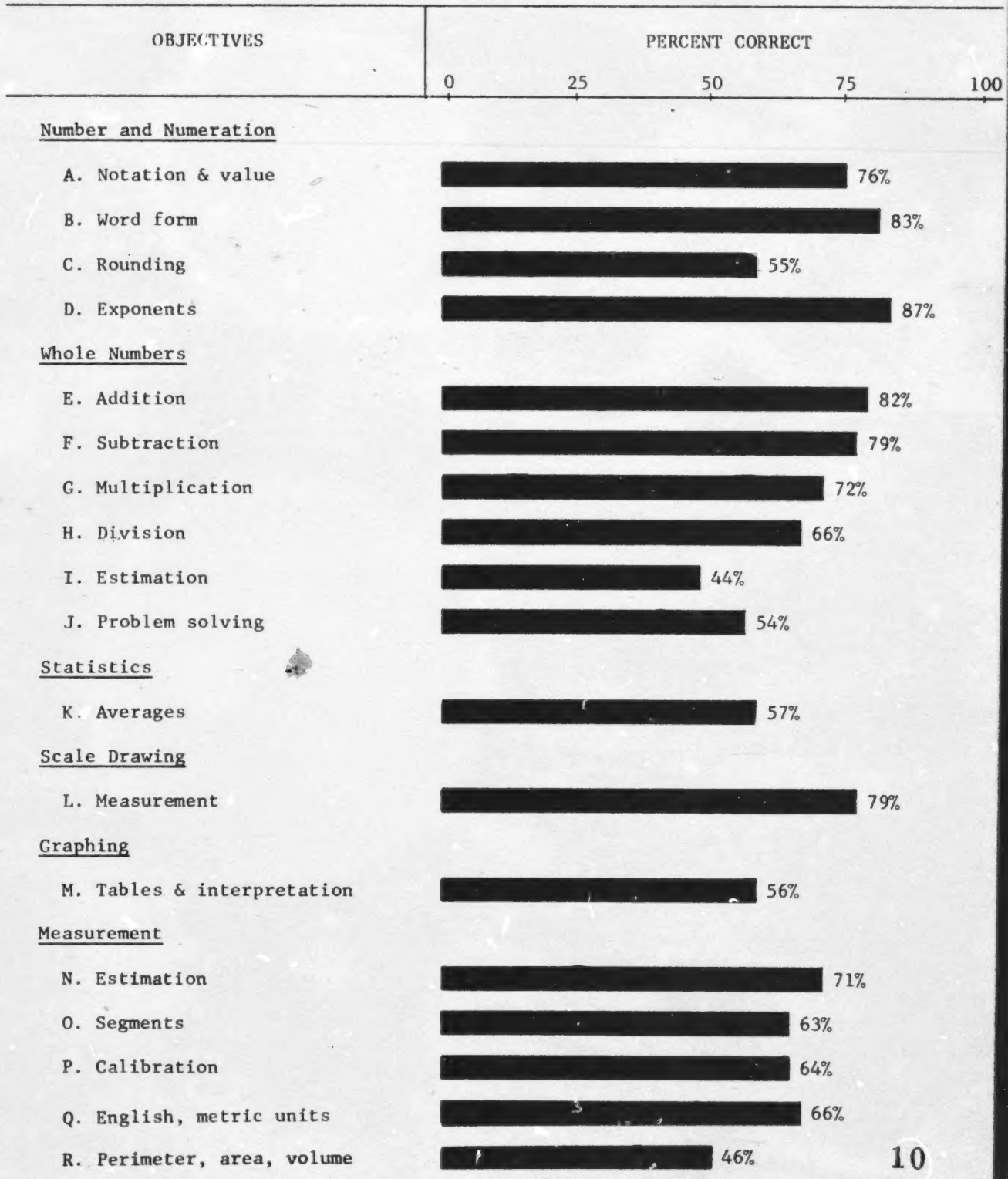
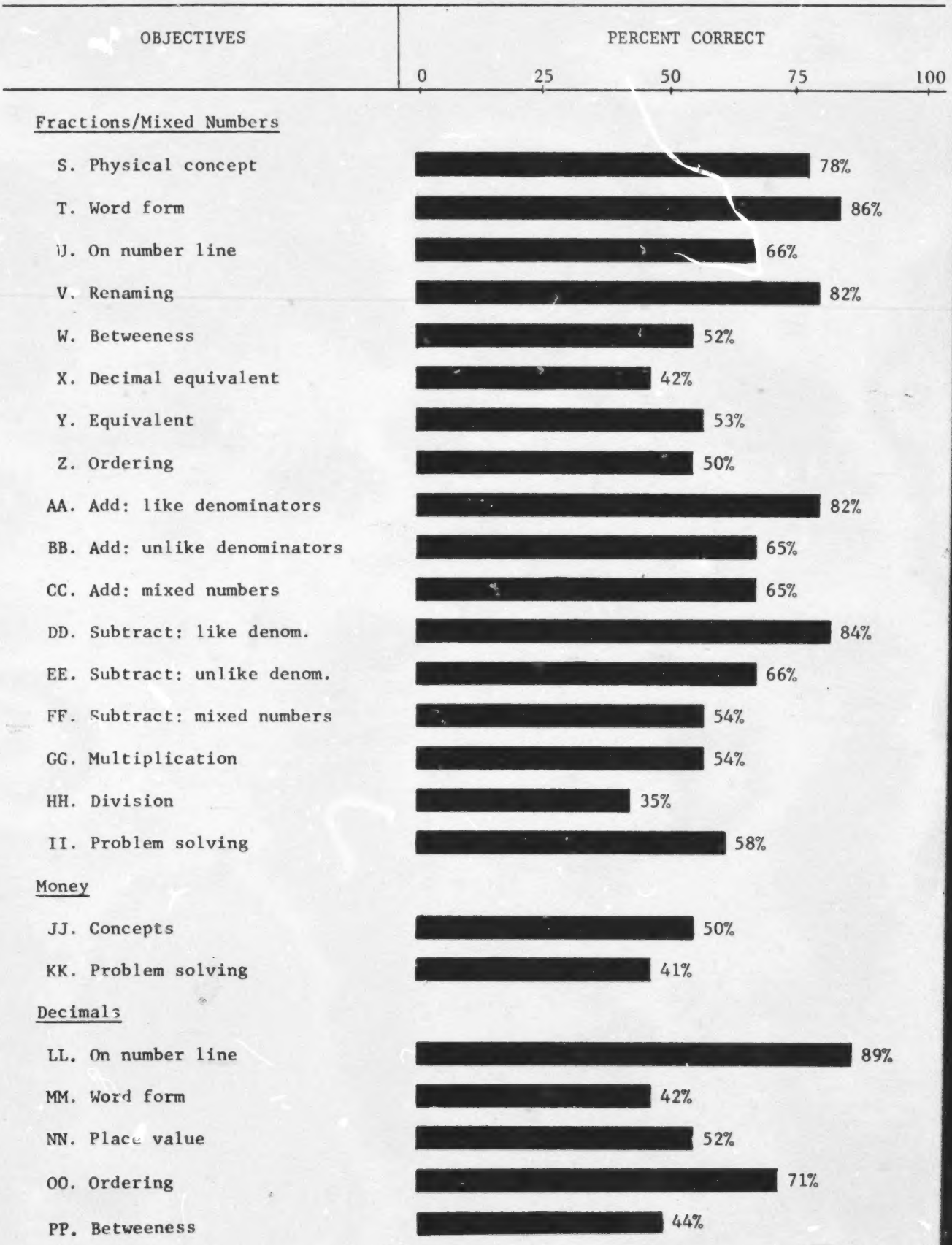
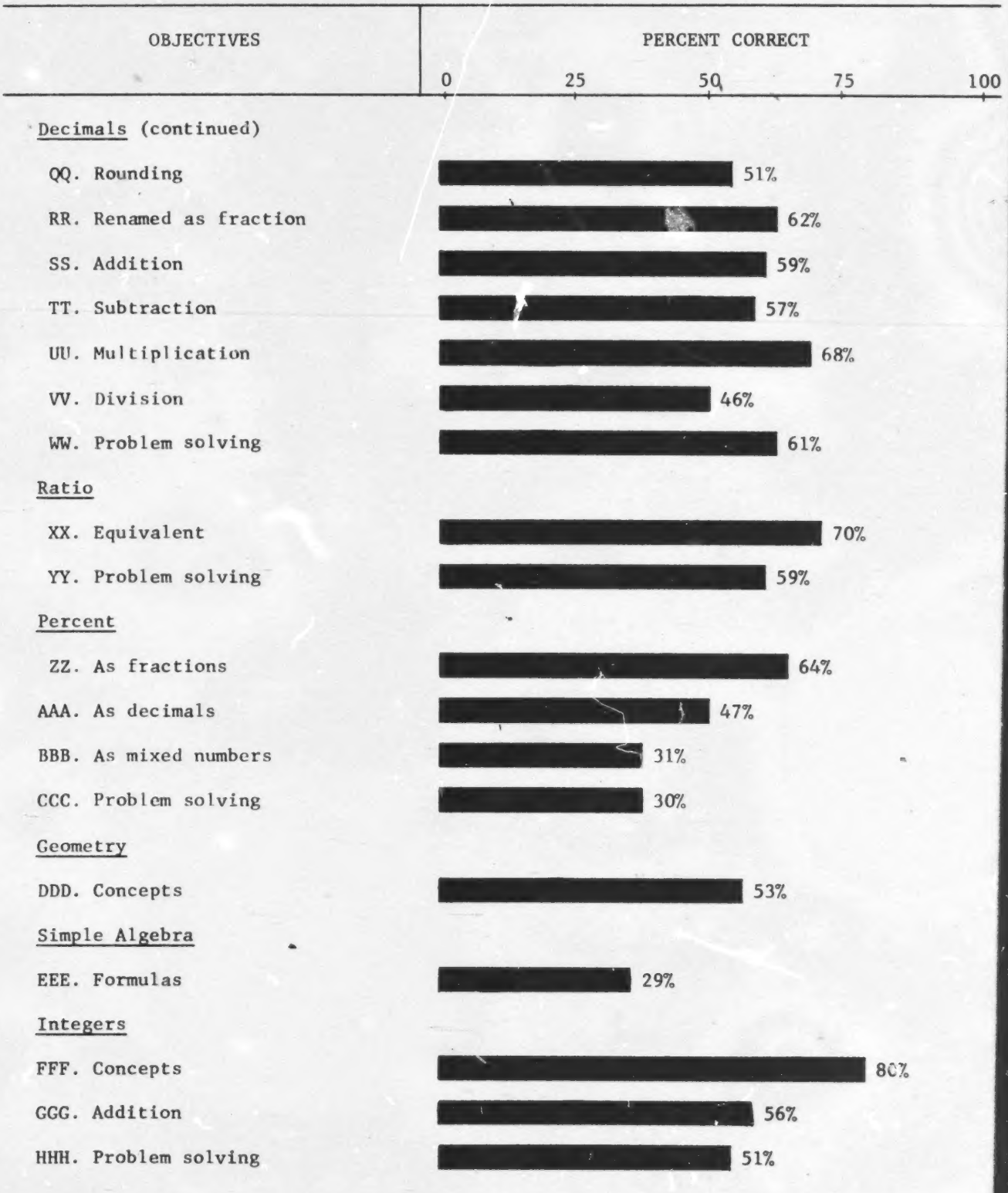
8TH GRADE STUDENT PERFORMANCE ON MATHEMATICS OBJECTIVES (16,131 Students)



GRADE 8


OBJECTIVES
PERCENT CORRECT
0
25
50
75
100
Fractions/Mixed Numbers
S. Physical concept
78%
T. Word form
86%
U. On number line
66%
V. Renaming
82%
W. Betweeness
52%
X. Decimal equivalent
42%
Y. Equivalent
53%
Z. Ordering
50%
AA. Add: like denominators
82%
BB. Add: unlike denominators
65%
CC. Add: mixed numbers
65%
DD. Subtract: like denom.
84%
EE. Subtract: unlike denom.
66%
FF. Subtract: mixed numbers
54%
GG. Multiplication
54%
HH. Division
35%
II. Problem solving
58%
Money
JJ. Concepts
50%
KK. Problem solving
41%
Decimals
LL. On number line
89%
MM. Word form
42%
NN. Place value
52%
OO. Ordering
71%
PP. Betweeness
44%

GRADE 8


OBJECTIVES
PERCENT CORRECT
0
25
50
75
100
Decimals (continued)
QQ. Rounding
51%
RR. Renamed as fraction
62%
SS. Addition
59%
TT. Subtraction
57%
UU. Multiplication
68%
VV. Division
46%
WW. Problem solving
61%
Ratio
XX. Equivalent
70%
YY. Problem solving
59%
Percent
ZZ. As fractions
64%
AAA. As decimals
47%
BBB. As mixed numbers
31%
CCC. Problem solving
30%
Geometry
DDD. Concepts
53%
Simple Algebra
EEE. Formulas
29%
Integers
FFF. Concepts
80%
GGG. Addition
56%
HHH. Problem solving
51%

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OBJECTIVES FOR 8TH GRADE MATH

NUMBER AND NUMERATION

A. Notation & value
1. Write a whole number less than ten million in expanded notation.
2. Write the standard name for a number less than ten million which is written in expanded notation.
3. Identify the greatest number from a list of four whole numbers each of which is less than ten million.

B. Word form
4. Given a number less than ten million written in word form, write the standard name.
5. Given a number less than ten million, write it in word form.

C. Rounding
6. Given a number less than ten million, round it to any indicated place.

D. Exponents
7. Given a whole number with a positive exponent, write it in expanded form.
8. Write a series of like factors in exponential notation.

WHOLE NUMBERS (COMPUTATION)

E. Addition
9. Determine the sum of two, three, or four addends if each of the addends is seven digits or less.

F. Subtraction
10. Determine the difference of two numbers if each of the numbers is less than ten million.

G. Multiplication
11. Determine the product of two numbers if each of the numbers is less than one thousand.

H. Division
12. Determine the quotient of two numbers when the dividend is less than one million and the divisor is less than one thousand.

WHOLE NUMBERS (PROBLEM SOLVING)

I. Estimation
13. Estimate the solution to a word problem.

J. Problem solving
14. Determine the solution to a one-operation word problem.
15. Determine the solution to a multiple-operation word problem.
16. Select from a list the question(s) that cannot be answered from the information given.
17. Identify the additional information needed to determine the solution to a word problem.
18. Identify the operation(s) to use to determine the solution to a word problem.

STATISTICS

K. Averages
19. Determine the average (mean) of a set of numbers.

SCALE DRAWINGS

L. Measurement
20. Determine a measurement from a scale drawing or map.

GRAPHING

M. Tables & interpretations
21. Select a table that describes a set of data.
22. Interpret and draw conclusions from circle, bar, or line graphs.

MEASUREMENT

N. Estimation
23. Estimate a linear distance (no instruments) in the conventional (English) system.
24. Estimate a linear distance (no instruments) in the metric system.

O. Segments
25. Determine the length of a line segment to the nearest inch, 1/2 inch, 1/4 inch, or 1/8 inch.
26. Determine the length of a line segment to the nearest centimeter.

P. Calibration
27. Identify the calibrated units on a yardstick.
28. Identify the calibrated units on a meter stick.

Q. English, metric units
29. Demonstrate knowledge of: (conversion within either metric or English system).
30. Convert between units in the metric system (kilo, centi, milli).
31. Write an equivalent measure for a conventional (English) measure.

R. Perimeter, area, volume
32. Determine the perimeter of a polygon.
33. Determine the approximate area of a polygon super-imposed on a grid.
34. Determine the area of a triangle.
35. Determine the area of a rectangle.
36. Determine the volume of a prism marked in cubical units.
37. Determine whether area, perimeter or volume is the concept involved in a word problem.

FRACTIONS (CONCEPTS)

S. Physical concept
- 38. Write a fraction that describes the shaded portion of a given display.

T. Word form
- 39. Write the word form of a fraction.

U. On a number line
- 40. Locate a given fraction on a number line.
- 41. Name the fraction indicated by a point on a number line.

V. Renaming
- 42. Rename an improper fraction as a mixed number or a whole number.
- 43. Rename a mixed number as an improper fraction.
- 44. Rename a whole number as a fractional number.
- 45. Write a fraction in simplest terms.

W. Betweeness
- 46. Write a fraction that is between two given fractions.

X. Decimal equivalent
- 47. Rename a fraction as a decimal fraction.

Y. Equivalent
- 48. Select from a list the fractions equivalent (equal) to a given fraction.

Z. Ordering
- 49. Write three fractions with unlike denominators in order from least to greatest.

FRACTIONS (COMPUTATION)

AA. Add: like denominators
- 50. Add two or three like proper fractions.

BB. Add: unlike denominators
- 51. Add two or three unlike proper fractions.

CC. Add: mixed numbers
- 52. Add two or three like fractions (combination of mixed numbers and proper fractions).
- 53. Add two or three unlike fractions (combination of mixed numbers and proper fractions).

DD. Subtract: like denominators
- 54. Determine the difference of two like proper fractions.

EE. Subtract: unlike denominators
- 55. Determine the difference of two unlike proper fractions.

FF. Subtract: mixed numbers
- 56. Subtract a proper fraction or mixed number from a mixed number (unlike denominators and no regrouping).
- 57. Subtract a proper fraction or mixed number from a mixed number (unlike denominators and regrouping).
- 58. Subtract a proper fraction or mixed number from a whole number.

GG. Multiplication
- 59. Determine the product of two proper fractions.
- 60. Determine the product of two fractions (at least one a mixed number).

HH. Division
- 61. Divide a whole number by a proper fraction or mixed number.
- 62. Divide a proper fraction by a whole number.
- 63. Divide a mixed number by a whole number.

FRACTIONS (PROBLEM SOLVING)

II. Problem solving
- 64. Determine the solution to a one-operation word problem.
- 65. Determine the solution to a multiple-operation word problem.
- 66. Select from a list the question(s) that cannot be answered from the information given.
- 67. Identify the additional information needed to determine the solution to a word problem.
- 68. Identify the operation(s) to use to determine the solution to a word problem.
- 69. Determine the ingredients for more/less people when given a recipe for n people.

MONEY

JJ. Concepts
- 70. Determine the value of a set of U.S. coins and/or bills that is less than $100.
- 71. Determine the least number of coins and bills equal to a given amount of money.

KK. Problem solving
- 72. Determine the solution to a word problem.
- 73. Determine the "best" buy of similar items sold in different amounts (weight or quantity).

DECIMAL FRACTIONS (CONCEPTS)

LL. On a number line
- 74. Locate a decimal fraction on a number line.
- 75. Name the decimal fraction indicated by a point on a number line

MM. Word form
- 76. Write the word form of a decimal fraction.

NN. Place value
- 77. Identify the place value of any digit in a decimal fraction.

OO. Ordering
- 78. Write three or four decimal fractions in order from least to greatest.

PP. Betweeness
- 79. Name a decimal fraction that is between two given decimal fractions.

QQ. Rounding
- 80. Given a decimal fraction, round it to any indicated place.

RR. Rename as a fraction

81. Rename a terminating decimal fraction as a fraction.

DECIMAL FRACTIONS (COMPUTATION)

SS. Addition

82. Determine the sum of two, three, or four decimal fractions.

TT. Subtraction

83. Determine the difference of two decimal fractions.

UU. Multiplication

84. Determine the product of a decimal fraction and a whole number (decimal fractions to hundredths).

85. Determine the product of two decimal fractions (decimal fractions to hundredths).

VV. Division

86. Determine the quotient of a decimal fraction and a whole number (decimal fractions to hundredths).

87. Determine the quotient of two decimal fractions (divisors to hundredths and dividends to ten-thousandths).

DECIMAL FRACTIONS (PROBLEM SOLVING)

WW. Problem solving

88. Determine the solution to a one-operation word problem.

89. Determine the solution to a multiple-operation word problem.

90. Select from a list the question(s) that cannot be answered from the information given.

91. Identify the additional information needed to determine the solution to a word problem.

92. Identify the operation(s) to use to determine the solution to a word problem.

RATIO

XX. Equivalent

93. Determine if two ratios are equivalent.

94. Determine the missing part of a number sentence involving ratios.

YY. Problem solving

95. Determine the solution to a word problem.

PERCENT

ZZ. As fractions

96. Write a proper fraction as a percent.

97. Write a commonly used percent as a fraction.

AAA. As decimals

98. Write a decimal fraction as a percent.

BBB. As mixed numbers

99. Write a mixed number as a percent.

CCC. Problem solving

100. Determine a specified percent of a number.

101. Determine the solution to a word problem.

102. Determine the solution to a word problem based on discount, interest, or commission.

GEOMETRY

DDD. Concepts

103. Identify the circles, squares, rectangles, and triangles in a display.

104. Identify the center, radius (radii), and diameter(s) in a circle diagram.

105. Classify a described model as being one-dimensional, two-dimensional, or three-dimensional.

SIMPLE ALGEBRA

EEE. Formulas

106. Determine the value of one variable of a formula, given the whole number values of the other variables.

INTEGERS

FFF. Concepts

107. Write an integer to describe a direction, movement, or profit/loss situation.

108. Locate an integer on a number line.

109. Name the integer indicated by a point on a number line.

GGG. Addition

110. Determine the sum of two, three, or four integers.

HHH. Problem solving

111. Determine the solution to a one-operation word problem.

Comments

Contrary to many of the recent criticisms that students lack basic math skills, the results of the Iowa Assessment show that a large majority of students have acquired a good foundation in mathematics. Evidence of success can be noted on computation of whole numbers in both fifth and eighth grade. The per cent of success declined somewhat on computation of fractions, decimals and percentages, but students should have an opportunity to further develop these skills during the remainder of the school year.

Performance of eighth grade students on word problems reveal that slightly more than one-half of the students were able to apply previously learned skills when confronted with a problem solving situation. The lower rate of success may be partially attributed to the type of word problems used in the assessment. A number of problems required the student to analyze the information carefully in order to discard the extraneous data prior to solving the problem. The student's previous experience with this type of problem may have been extremely limited.

Results indicate that when students are confronted with a word problem where they are required to estimate or approximate a reasonable answer, more than 50 percent of the students are unable to select the "best estimate". Math programs have not stressed this skill in the past, but with the increased dependence upon pocket calculators and other automatic calculating equipment, it becomes much more crucial to be able to judge the reasonableness of an answer.

One could speculate further on the results of state assessment, but the crucial judgments regarding the use of the data must be made by the local school staff. Some questions that should be raised by the teachers as a result of the assessment include:

1) Was the overall performance of students satisfactory?
2) Which students did not perform satisfactorily?
3) What were their skill deficiencies?
4) How serious are these deficiencies?
5) What are the consequences if nothing is done about correcting the deficiencies?
6) What resources are available to assist with the problem?
7) How long will it take to resolve the problem?
8) What action can be taken to prevent similar problems from occurring?
9) What skill maintenance activities are necessary for all students?
10) What other objectives should be included in the assessment?

Seeking answers to the above questions or a similar set developed by the teachers should enable schools to pinpoint the problem and to allocate resources to resolve the situation.